

International Space Environment Service



Terry Onsager, representing ISES Members
NOAA Space Weather Prediction Center
Director, International Space Environment Service



International Space Environment Service

Coordinating space weather services since 1962



ISES
International Space
Environment Service



World Meteorological
Organisation

- Endorsed by national governments as space weather service providers
- Network Member of the ICSU World Data Service
- Formal exchange of letters with the WMO
- Provide local users with targeted services
- Coordinated world-wide operational effort

18 Regional Warning Centers

4 Associate Warning Centers

1 Collaborative Expert Center





Mission: Improve, Coordinate, and Deliver Operational Space Weather Services

Four elements needed to improve space weather capabilities:

- | | |
|------------------------------|--|
| 1. User Needs: | Understand the risks and the actions that need to be taken |
| 2. Targeted Services: | Develop useable capabilities from basic science knowledge |
| 3. Observing Infrastructure: | Shared approach for long-term continuity |
| 4. Global Coordination: | Consistent, accurate message |

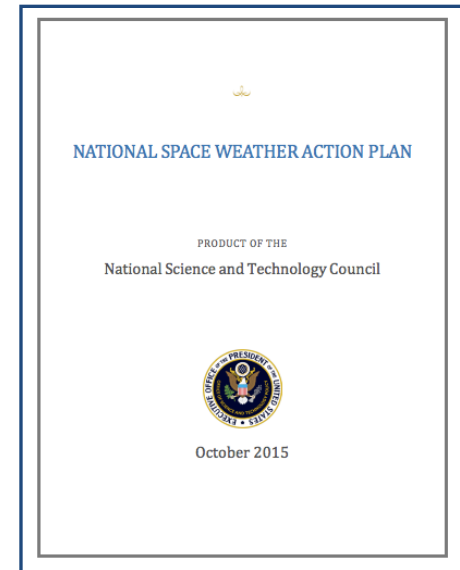


U.S. Perspective: Increase International Cooperation

Goal 6 of the U.S. National Space Weather Action Plan

Strengthen international coordination and cooperation on space weather products and services

- Sustain engagement with ISES
- Ensure global consistency during extreme events
- Sustain operational baseline observing capabilities



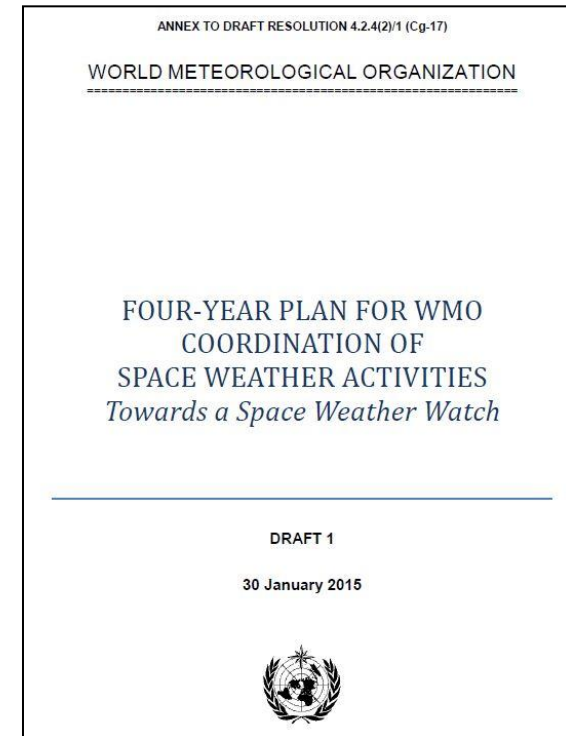


ISES in the Broader Context: World Meteorological Organization

Formal collaboration established between ISES and WMO

Goals within the WMO Four-Year Plan:

- Promote sustained observations essential for space weather services
- Improve exchange of data and information
- Support coordination of services for aviation and other major application sectors
- Improve emergency warning and global preparedness



WMO Space
Programme Elements:

Space-based
Observing System



Access to Satellite
Data and Products



Awareness and
Training



Space Weather
Coordination



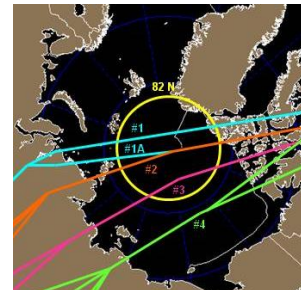


Space Weather Service Requirements for International Civil Aviation

ICAO is developing provisions for space weather information to international air navigation, including:

- Requirements for space weather services
- Criteria for space weather information providers

ISES Members are key participants in ICAO activities and will be involved in the provision of services.





United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)

UNISPACE+50 Initiative – To be commemorated in 2018

- Celebrate 50th anniversary of United Nations Conference on the Exploration and Peaceful Uses of Outer Space
- Serve as a blueprint for shaping the “Space 2030” agenda
- Strengthen reliability of space systems to space weather

Seven Thematic Priorities identified for UNISPACE+50

Priority 4: *International framework for space weather services*

Develop a space weather roadmap for coordination and information exchange on space weather events and mitigation

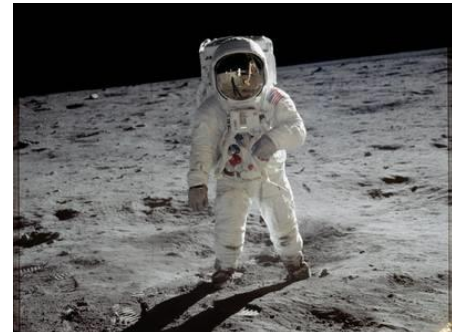
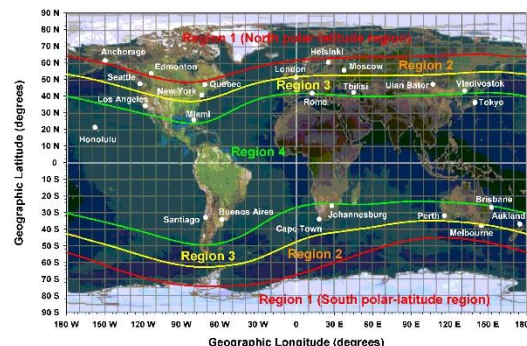
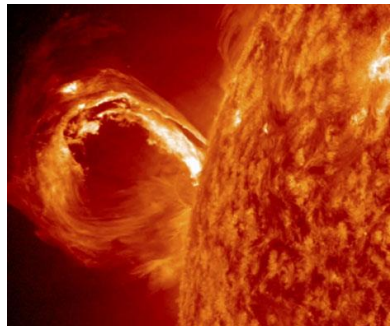
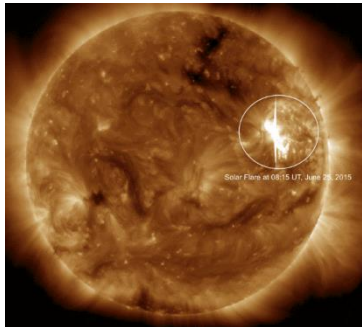




ISES Action – Rapid Access Information

Enable immediate access to key alerts and warnings from all Regional Warning Centers

- Provide rapid situational awareness during extreme events
- Ensures immediate knowledge of regional events
- Supports National Space Weather Action Plan goal to ensure global consistency during extreme events

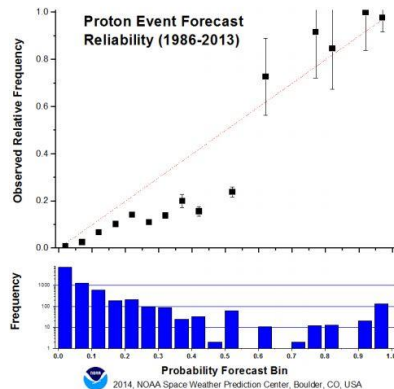




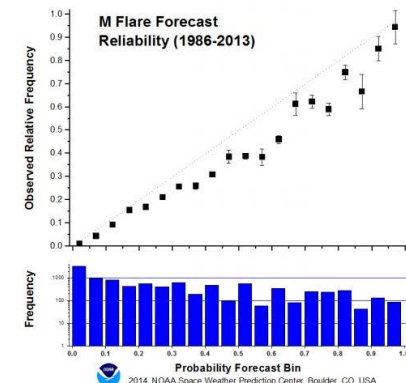
ISES Actions – Forecast Verification

Explore standard probabilistic forecasts and verification

- Value of standardized verification methods acknowledged
- Extensive expertise is available at ISES Centers
- Actions are underway to compare approaches and make recommendations on verification techniques



		K6 Observed	
		YES	NO
K6 Warning Issued	YES	HIT 194	FALSE ALARM 72
	NO	MISS 81	Correct Null 43,485





Newest ISES Member - Indonesia

Space Weather Information and Forecast Services – ISES Regional Warning Center

- Emphasis on equatorial ionospheric disturbances
 - HF communications users, Indonesian satellite operations, and geological surveying



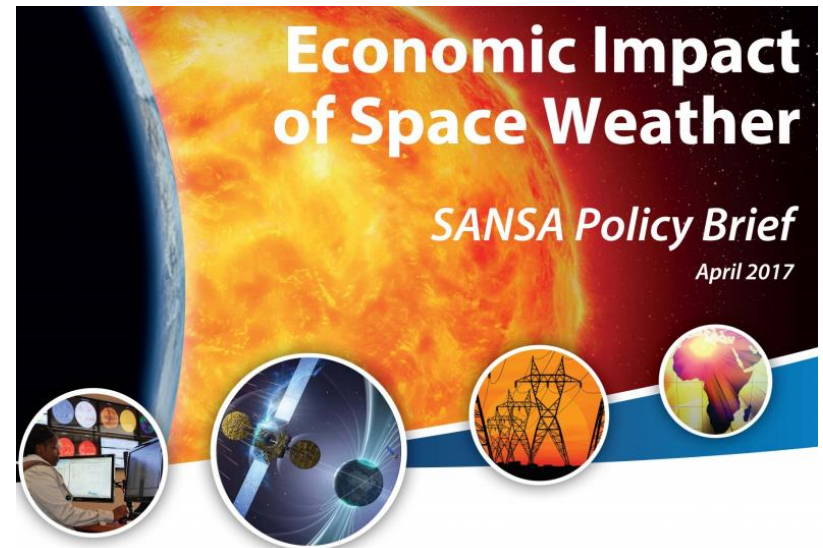


Economic Impact Study

UK, ESA, and U.S. studies highlighted earlier this week.

South African National Space Agency – ISES Regional Warning Center

- Overview and recommendations focused on Africa:
 - Energy
 - Security
 - Communication and Navigation
 - Health
 - Transportation





Space Weather User Workshops

Australia Bureau of Meteorology – ISES Regional Warning Center

- Meeting of stakeholders and customer survey
- Aviation Space Weather Services Workshop
 - Present prototype industry-specific products
 - Obtain feedback and industry requirements





Space Weather User Workshops

China National Space Science Center – ISES Associate Warning Center

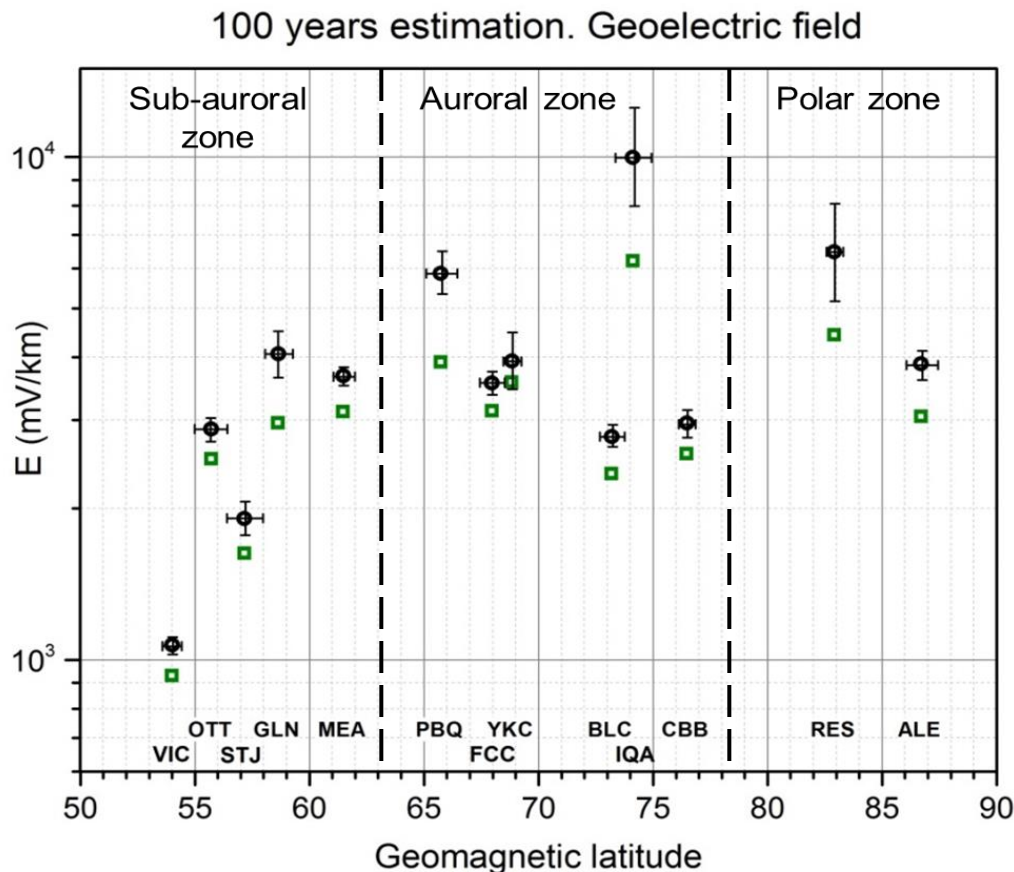
Ninth National Symposium on Space Environment and Applications in China - 2016





Characterizing Extreme Events

Natural Resources Canada – ISES Regional Warning Center



- 40 year of data
- 13 Canadian magnetometers

Maximum measured

Estimated extreme



Models, Products, and Services

China National Space Science Center – ISES Associate Warning Center

- ❑ Ionospheric Assimilation Models and Products
- ❑ Operational CME propagation forecast system
- ❑ Space Situation Environmental Awareness System
- ❑ Space Environment Teaching and Practice Software
- ❑ Space Environment Services for China Space Flight Missions
 - Tiangong II
 - Dark Matter Particle Explorer Satellite
 - The retrievable Shijian-10
 - Quantum Science Satellite



Models, Products, and Services


Australia Bureau of Meteorology – ISES Regional Warning Center

- Ionosphere model to support National Positioning Infrastructure
 - National initiative to provide accurate PNT across Australia
 - Target is an accurate, 3-D, real-time ionosphere model
- MHD model to predict IMF Bz
 - Collaboration with University of Sydney
 - Utilizes University of Michigan BATS-R-US model



Models, Products, and Services

Kanzelhöhe Observatory, Austria – ISES Regional Warning Center

**esa** space situational awareness
European Space Agency

[SSA](#) [SSA](#) [SWE](#) [NEO](#) [SST](#)

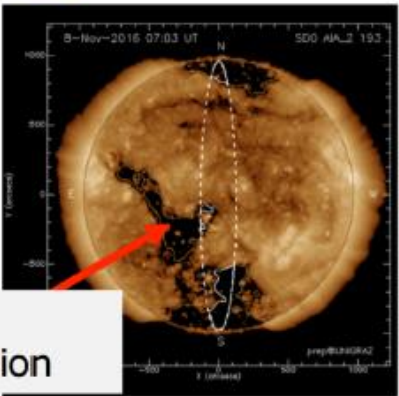
About SWE
What is Space Weather
SSA Space Weather Activities
Current Space Weather
Contact
Applications Preferences

Service Domains
Spacecraft Design
Spacecraft Operation
Human Space Flight
Launch Operation
Transionospheric Radio Link
Space Surveillance and Tracking
Power Systems Operation
Airlines
Resource Exploitation System Operation
General Data Service

Expert Service Centres
Solar Weather
Space Radiation
Ionospheric Weather
Geomagnetic Conditions
Heliospheric Weather

Other Resources
Documents
SWWT
SWEN Newsletter
Upcoming Events

Sign-In
Roland Maderbacher is signed in
Sign Out

Federated products from the University of Graz (UNIGRAZ)
ESWF (Empirical Solar Wind Forecasting)

CH detection

Critical SW speed

Comparison to measurements (ACE, DSCOVR)

short-term Forecast (DSCOVR)

medium-term Forecast ACE/DSCOVR

long-term Forecast ACE

UNIVERSITY OF GRAZ

The ESWF uses an empirical relation to derive the solar wind speed at Earth distance (Vrenak, Temmer, Veronig, 2007). The Sun is monitored in EUV (NASA/SDO) from which coronal hole areas are extracted to calculate the solar wind speed at 1AU with a lead time of about 4 days (Reiss et al., 2016). We compare the forecast for three different time ranges to in-situ data (ACE/DSCOVR). The red dashed line marks the arrival of solar wind streams of enhanced speed. This service is updated automatically every hour.

This web page forms part of the ESA Space Situational Awareness Programme's network of space weather service development activities, and is supported under ESA contract number 4000113183/15/D/M/R. For further product-related information or enquiries contact helpdesk. E-mail: helpdesk.swe@esa.int. All publications and presentations using data obtained from this site should acknowledge UNIGRAZ and The ESA Space Situational Awareness Programme. For further information about space weather in the ESA Space Situational Awareness Programme see: www.esa.int/spaceweather. Access the SSA-SWE portal here: swe.ssa.esa.int.

ESWF



Summary

- International Space Environment Service - growing global network dedicated to operational space weather services
- Members are integrated with expanding international efforts
- Actions are under way to enhance global coordination
- Future directions:
 - Understanding social/economic impacts
 - Sharing user needs and post-event information
 - Rapid dissemination of event information
 - Common verification techniques and metrics
 - Sharing research/application developments